

OPERATIONAL AMPLIFIERS

HIGHLY MATCHED MONOLITHIC DUAL OPERATIONAL AMPLIFIERS

... designed for use as summing amplifiers, integrators, or amplifiers with operating characteristics as a function of the external feedback components. Ideal for chopper stabilized applications where extremely high gain is required with excellent stability.

Typical Amplifier Features:

- High-Performance Open Loop Gain Characteristics – $A_{VOL} = 45,000$ typical
- Low Temperature Drift – $\pm 3 \mu V/^{\circ}C$
- Large Output Voltage Swing – $\pm 14 V$ typical @ $\pm 15 V$ Supply

MAXIMUM RATINGS (T_A = +25°C)

Rating	Symbol	Value	Unit
Power Supply Voltage	V ⁺ V ⁻	+18 -18	Vdc Vdc
Differential Input Signal	V _{in}	±5.0	Volts
Common Mode Input Swing	CMV _{in}	±V ⁺	Volts
Output Short Circuit Duration	t _S	5.0	s
Power Dissipation (Package Limitation)	P _D		
Ceramic Package		750	mW
Derate above T _A = +25°C		6.0	mW/°C
Plastic Package		625	mW
Derate above T _A = +25°C		5.0	mW/°C
Operating Temperature Range MC1537 MC1437	T _A	-55 to +125 0 to +75	°C
Storage Temperature Range	T _{sta}	-65 to +150	°C

**DUAL MC1709
MONOLITHIC SILICON
OPERATIONAL AMPLIFIERS
INTEGRATED CIRCUIT**

P SUFFIX
PLASTIC PACKAGE
CASE 605
TO-116



(MC1437 only)

(top view)

L SUFFIX
CERAMIC PACKAGE
CASE 632
TO-116



FIGURE 1 – CIRCUIT SCHEMATIC

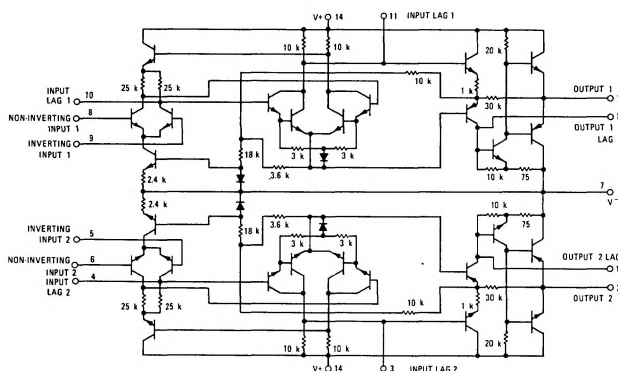
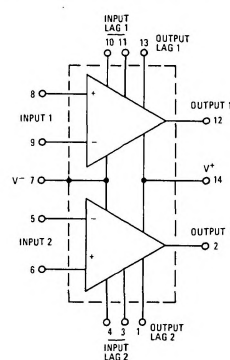


FIGURE 2 – EQUIVALENT CIRCUIT



See Packaging Information Section for outline dimensions.

MC1537, MC1437 (continued)

ELECTRICAL CHARACTERISTICS — Each Amplifier ($V^+ = +15$ Vdc, $V^- = -15$ Vdc, $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	MC1537			MC1437			Unit
		Min	Typ	Max	Min	Typ	Max	
Open Loop Voltage Gain ($R_L = 5.0\text{ k}\Omega$, $V_O = \pm 10\text{ V}$, $T_A = T_{\text{low}} \text{ ① to } T_{\text{high}} \text{ ②}$)	A_{VOL}	25,000	45,000	70,000	15,000	45,000	—	—
Output Impedance ($f = 20\text{ Hz}$)	Z_O	—	30	—	—	30	—	Ω
Input Impedance ($f = 20\text{ Hz}$)	Z_{in}	150	400	—	50	150	—	$\text{k}\Omega$
Output Voltage Swing ($R_L = 10\text{ k}\Omega$) ($R_L = 2.0\text{ k}\Omega$)	V_O	± 12 ± 10	± 14 ± 13	— —	± 12 —	± 14 —	— —	V_{peak}
Input Common-Mode Voltage Swing	CMV_{in}	± 8.0	± 10	—	± 8.0	± 10	—	V_{peak}
Common-Mode Rejection Ratio	CM_{rej}	70	100	—	65	100	—	dB
Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$ ($T_A = +25^\circ\text{C}$) ($T_A = T_{\text{low}} \text{ ①}$)	I_b	— —	0.2 0.5	0.5 1.5	— —	0.4 —	1.5 2.0	μA
Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, $T_A = T_{\text{low}} \text{ ①}$) ($I_{io} = I_1 - I_2$, $T_A = T_{\text{high}} \text{ ②}$)	$ I_{io} $	— — —	0.05 — —	0.2 0.5 0.2	— — —	0.05 — —	0.5 0.75 0.75	μA
Input Offset Voltage ($T_A = +25^\circ\text{C}$) ($T_A = T_{\text{low}} \text{ ① to } T_{\text{high}} \text{ ②}$)	$ V_{io} $	— —	1.0 —	5.0 6.0	— —	1.0 —	7.5 10	mV
Step Response { Gain = 100, 5% overshoot, $R_1 = 1\text{ k}\Omega$, $R_2 = 100\text{ k}\Omega$, $R_3 = 1.5\text{ k}\Omega$, $C_1 = 100\text{ pF}$, $C_2 = 3.0\text{ pF}$ } { Gain = 10, 10% overshoot, $R_1 = 1\text{ k}\Omega$, $R_2 = 10\text{ k}\Omega$, $R_3 = 1.5\text{ k}\Omega$, $C_1 = 500\text{ pF}$, $C_2 = 20\text{ pF}$ } { Gain = 1, 5% overshoot, $R_1 = 10\text{ k}\Omega$, $R_2 = 10\text{ k}\Omega$, $R_3 = 1.5\text{ k}\Omega$, $C_1 = 5000\text{ pF}$, $C_2 = 200\text{ pF}$ }	t_f t_{pd} $dV_{out}/dt \text{ ③}$ t_f t_{pd} $dV_{out}/dt \text{ ③}$ t_f t_{pd} $dV_{out}/dt \text{ ③}$	— — — — — — — — —	0.8 0.38 12 0.6 0.34 1.7 2.2 1.3 0.25	— — — — — — — — —	— — — — — — — — —	0.8 0.38 12 0.6 0.34 1.7 2.2 1.3 0.25	— — — — — — — — —	μs μs $\text{V}/\mu\text{s}$ μs μs $\text{V}/\mu\text{s}$ μs μs $\text{V}/\mu\text{s}$
Average Temperature Coefficient of Input Offset Voltage ($R_S = 50\text{ }\Omega$, $T_A = T_{\text{low}} \text{ ① to } T_{\text{high}} \text{ ②}$) ($R_S \leq 10\text{ k}\Omega$, $T_A = T_{\text{low}} \text{ ① to } T_{\text{high}} \text{ ②}$)	$ TCV_{io} $	— —	1.5 3.0	— —	— —	1.5 3.0	— —	$\mu\text{V}/^\circ\text{C}$
Average Temperature Coefficient of Input Offset Voltage ($T_A = T_{\text{low}} \text{ ① to } +25^\circ\text{C}$) ($T_A = +25^\circ\text{C}$ to $T_{\text{high}} \text{ ②}$)	$ TCI_{io} $	— —	0.7 0.7	— —	— —	0.7 0.7	— —	$\text{nA}/^\circ\text{C}$
DC Power Dissipation (Total) (Power Supply = $\pm 15\text{ V}$, $V_O = 0$)	P_D	—	160	225	—	160	225	mW
Positive Supply Sensitivity (V^- constant)	S^+	—	10	150	—	10	200	$\mu\text{V}/\text{V}$
Negative Supply Sensitivity (V^+ constant)	S^-	—	10	150	—	10	200	$\mu\text{V}/\text{V}$

① $T_{\text{low}} = 0^\circ\text{C}$ for MC1437
= -55°C for MC1537

② $T_{\text{high}} = +75^\circ\text{C}$ for MC1437
= $+125^\circ\text{C}$ for MC1537

③ dV_{out}/dt = Slew Rate

MATCHING CHARACTERISTICS

Open Loop Voltage Gain	$A_{VOL1} - A_{VOL2}$	—	± 1.0	—	—	± 1.0	—	dB
Input Bias Current	$I_{b1} - I_{b2}$	—	± 0.15	—	—	± 0.15	—	μA
Input Offset Current	$ I_{io1} - I_{io2} $	—	± 0.02	—	—	± 0.02	—	μA
Average Temperature Coefficient	$ TCI_{io1} - TCI_{io2} $	—	± 0.2	—	—	± 0.2	—	$\text{nA}/^\circ\text{C}$
Input Offset Voltage	$ V_{io1} - V_{io2} $	—	± 0.2	—	—	± 0.2	—	mV
Average Temperature Coefficient	$ TCV_{io1} - TCV_{io2} $	—	± 0.5	—	—	± 0.5	—	$\mu\text{V}/^\circ\text{C}$
Channel Separation ($f = 10\text{ kHz}$)	e_{out1} e_{out2}	—	90	—	—	90	—	dB

TYPICAL OUTPUT CHARACTERISTICS

FIGURE 3 – TEST CIRCUIT
 $V^+ = +15\text{ Vdc}$, $V^- = 15\text{ Vdc}$, $T_A = 25^\circ\text{C}$

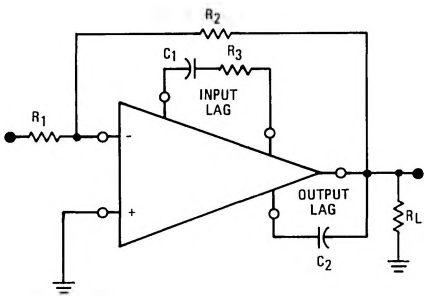


FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS					OUTPUT NOISE (mV/√ms)
			$R_1(\Omega)$	$R_2(\Omega)$	$R_3(\Omega)$	$C_1(\text{pF})$	$C_2(\text{pF})$	
4	1	1	10 k	10 k	1.5 k	5.0 k	200	0.10
	2	10	10 k	100 k	1.5 k	500	20	0.14
	3	100	10 k	1.0 M	1.5 k	100	3.0	0.7
	4	1000	1.0 k	1.0 M	0	10	3.0	5.2
5	1	1	10 k	10 k	1.5 k	5.0 k	200	0.10
	2	10	10 k	100 k	1.5 k	500	20	0.14
	3	100	10 k	1.0 M	1.5 k	100	3.0	0.7
	4	1000	1.0 k	1.0 M	0	10	3.0	5.2
6	1	A_{VOL}	0	∞	1.5 k	5.0 k	200	5.5
	2	A_{VOL}	0	∞	1.5 k	500	20	10.5
	3	A_{VOL}	0	∞	1.5 k	100	3.0	21.0
	4	A_{VOL}	0	∞	0	10	3.0	39.0
	5	A_{VOL}	0	∞	∞	0	3.0	—

FIGURE 4 – LARGE SIGNAL SWING
versus FREQUENCY

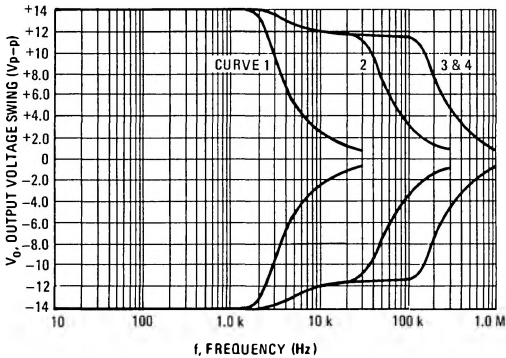


FIGURE 5 – VOLTAGE GAIN versus FREQUENCY

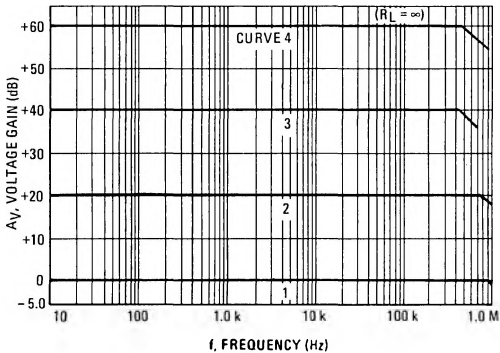


FIGURE 6 – OPEN LOOP VOLTAGE GAIN
versus FREQUENCY

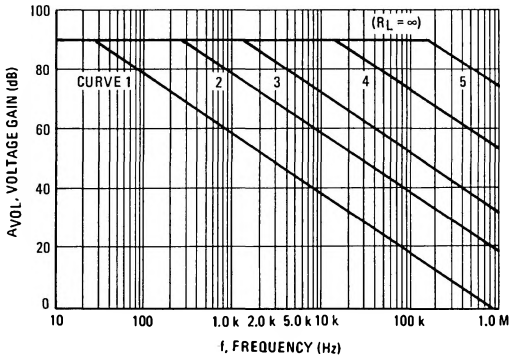
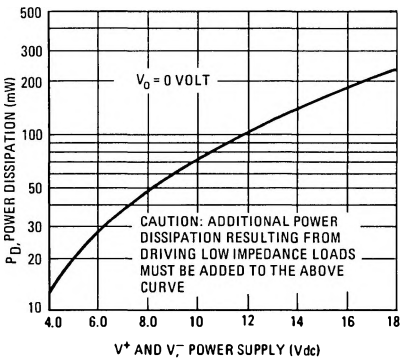


FIGURE 7 – TOTAL POWER DISSIPATION
versus POWER SUPPLY VOLTAGE



TYPICAL CHARACTERISTICS (continued)

FIGURE 8 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

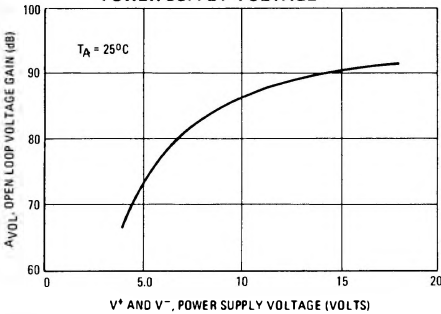


FIGURE 9 – COMMON INPUT SWING versus POWER SUPPLY VOLTAGE

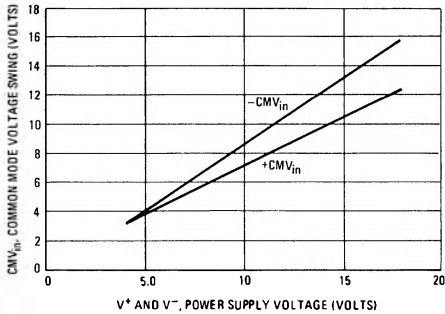


FIGURE 10 – INPUT OFFSET VOLTAGE versus TEMPERATURE

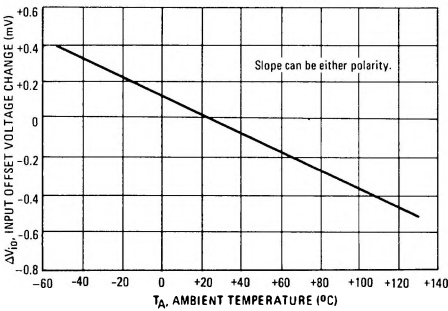


FIGURE 11 – OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE

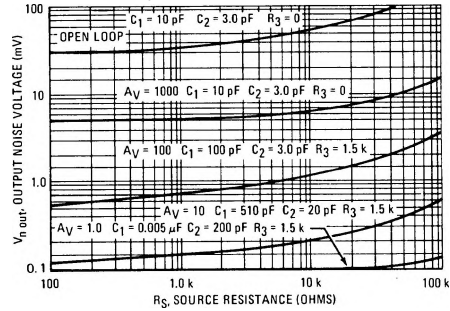
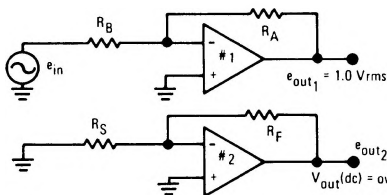
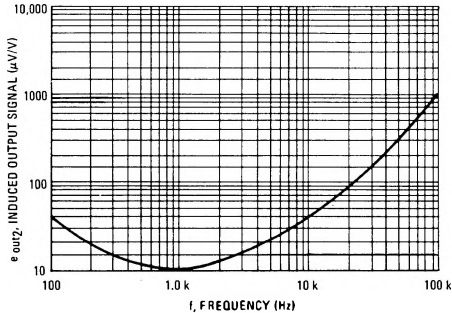


FIGURE 12 – INDUCED OUTPUT SIGNAL (CHANNEL SEPARATION) versus FREQUENCY



Induced output signal (μV of induced output signal in amplifier #2 per volt of output signal at amplifier #1).